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DFO Atlantic Fisheries
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Document de recherche **96/116**

An update on the Atlantic silverside fishery of Prince Edward Island, 1995

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Research documents are produced in the official language in which they are provided to the secretariat.

[1]La présente série documente les bases scientifiques des évaluations des ressources halieutiques sur la côte Atlantique du Canada. Elle traite des problèmes courants selon les échéanciers dictés. Les documents qu'elle contient ne doivent pas être considérés comme des énoncés définitifs sur les sujets traités, mais plotôt comme des rapports d'étape sur les études en cours.

Les documents de recherche sont publiés dans la langue officielle utilisée dans le manuscrit envoyé au secrétariat.

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Abstract

Prince Edward Island is the main fishing area in North America for the Atlantic silverside (*Menidia menidia*). Since 1973, a commercial fishery based on traps set in coastal waters has produced landings averaging 130 tonnes annually, with a peak of 543 tonnes in 1994. 1995 landings were 222 tonnes. Logbook records from six sites indicated a mean catch rate of 634 kg per trap per day. Fish aged 0+ comprised 88.3% by number of sampled catch. It is difficult to estimate sustainable harvest levels for silversides because of their short life span. The large number of inactive licences poses a potential risk to silversides as fishing effort could rise sharply if market demand increases.

Résumé

L'Île du Prince Édouard est le lieu principal de la pêche à la capucette (*Menidia menidia*) en Amérique du nord. Depuis 1973, une pêche commerciale basée sur les trappes installées dans les eaux cotières a récolté une prise moyenne de 130 tonnes par an. La prise maximum était 543 tonnes en 1994, et les débarquements en 1995 étaient 222 tonnes. Les journaux de bord indiquent un taux de prise moyen de 634 kg par trappe par jour en 1995. Les poissons agés de 0+ ans constituaient 88.3% des échantillons par nombre. À cause de leur courte durée de vie, il est difficile à estimer la récolte soutenable des capucettes. Le grand nombre de licences inactives posent un risque potentiel vu que l'effort de pêche pourrait monter en flèche si la demande du marché augmente.

Introduction

The Atlantic silverside (*Menidia menidia*) is a small schooling fish that ranges from the southern Gulf of St. Lawrence to Florida (Scott and Scott 1988). Silversides have a brief life cycle, with only a minority of fish reaching the age of two years (Jessop 1983). Fish spawn in the summer and 0+ fish form the bulk of the population in the following fall. The species is encountered mostly near shorelines, especially in estuaries and coastal ponds, but it may also undergo offshore migrations in winter.

Silversides are not commercially exploited throughout most of their range, but a small fishery has existed on Prince Edward Island since 1973. With the exception of a small catch in southeastern New Brunswick in 1982, PEI accounts for all Canadian landings (LeBlanc and Chaput 1991). The PEI fishery also lands the majority of all reported catches in North America (Chaput and LeBlanc 1991).

This paper reports catch rates and biological data from the 1995 silverside fishery on Prince Edward Island. Earlier investigations of PEI silversides were reported by Lewis and Cavanagh (1973), Lewis et al. (1974, 1975), and Jessop and Morantz (1982). Jessop (1983) described silverside life history in the Annapolis River, Nova Scotia.

Description of Fisheries

Silversides were commercially caught in Prince Edward Island in the 1940s (Jessop and Morantz 1982). They were also used as feed for PEI's early fox industry by at least one rancher (Lewis et al. 1975). The modern commercial fishery began in 1973, when a beach seine was used to capture silversides in a coastal pond at Little Harbour, east of Souris (Fig. 1) (Lewis and Cavanagh 1973). Some silversides were also taken at Cardigan in 1973. Seining achieved a high catch rate (5875 kg per day over 24 fishing days at Little Harbour), but the silt riled by dragging the net over the bottom contaminated the catch with dirt, and there were concerns that the high capture efficiency could eliminate local stocks.

In 1974, traps were introduced and this has remained the principal gear in the silverside fishery ever since. From its initial base in eastern Prince Edward Island, silverside fishing gradually spread across PEI, and landings have been reported from most statistical districts (although Jessop and Morantz (1982) caution that catches are sometimes reported from districts where the fish are sold, rather than where they are caught). However, the bulk of the landings continue to come from the eastern part of the province, particularly the Souris area (Table 1).

In early years silversides were sold primarily to the Japanese food market. More recently, most landings have been sold in the United States as food for exotic birds in zoos, and as angling bait.

Silversides may be taken only from 1 October to 31 December, and most landings occur in October and November (Table 2). Landings have also been made in January and February, outside the legal season. According to industry sources, these fish were taken from ponds which had not yet frozen over.

Silversides may be caught by trap nets and sweep nets (referred to in regulations as "dip nets"). Catches by sweep nets are negligible. Traps are deployed in estuaries, harbours or in brackish ponds connected to the sea. No silverside fishery is permitted in Nova Scotia and New Brunswick, and Prince Edward Island is the only province where the species is presently harvested.

Landings have fluctuated irregularly since the inception of the modern fishery in 1973 (Table 1, Fig. 2). Landings in 1994 were the highest on record, and were more than four times greater than the mean of the time series. Because of the exceptional landings of 1994, some buyers still had unsold stock at the beginning of the 1995 fishery, which depressed the market for that year. Nevertheless landings in 1995 were the third highest in the time series, and nearly double the long term mean.

The number of silverside licences rose from 11 to 44 between 1984 and 1993 (Table 2). The strong fishery of 1994 attracted widespread interest in silversides, and the number of licences more than doubled to 103 in that year. Seventy-two licence-holders were authorized to fish one trap, 21 were authorized to fish two traps, seven were authorized to fish three traps, and two were authorized to fish four traps. Seven licence-holders were authorized to use sweep nets ("dip nets"). In 1995, a freeze on the issuance of new licences was imposed. Because of limitations on markets and on suitable places to fish, only a minority of licence-holders actually fished in 1995.

Fisheries data

Daily landings were recorded by two logbook fishermen who fished at Hospital Pond in Charlottetown, Winter River, Souris, and Little Harbour (Fig. 1). Because nets were not fished on all days, the trap's daily catch was calculated as the total catch of the haul divided by the number of days since the trap was last emptied. One fisherman recorded landings on the basis of plant sales rather than trap hauls. His daily catch was calculated as the plant sale divided by the number of days since the last sale.

Mean catch rate ranged from 329 to 1334 kg per trap per day, with an overall mean of 634 kg per trap (Table 3). Catch rates differed significantly among sites (based on log-transformed daily catch figures including those meaned from a multi-day catching period, $F=7.1$, $P=.00001$, Table 3). Exact standard deviations cannot be calculated for these catch rates because true catches for individual fishing days are unknown; hence this test may overestimate significance levels. Catch rates were much higher than those recorded in 1979 by trap fishermen, who caught a mean of 76 kg per trap per day (Jessop and Morantz 1982). The highest mean catch (1334 kg per trap per day) and the longest fishing season (40 days) was reported from the pond at Little Harbour, where the modern fishery began in 1973. In November-December 1975, a trap in this pond caught a mean of 1904 kg per day over 32 days (Lewis et al. 1975).

Sticklebacks (pinfish) are commonly taken in silverside nets, and if present in sufficient numbers, can make the catch unacceptable to buyers. Sticklebacks were reported in troublesome numbers on some days at all sites. Fishermen indicated that excessive stickleback catches are a common incentive for changing fishing locations, or of closing a fishery early.

At Winter River, the logkeeper reported that his nets commonly take tomcod and large trout as bycatch, as well as several dozen eels per season. He also said the nets caught a rough average of six juvenile hake, about 22 cm long, per day. According to the Souris area logkeeper, his traps take a few dozen smelts per year, and occasionally sand lance, striped bass, and small mackerel. They never catch hake. Seals frequently visited the traps at Souris and the logkeeper reported that their depredations substantially reduced catches.

Samples for biological analysis were taken from logbook traps, from silverside traps in Murray River, and from a smelt net in the Boughton River. The Boughton samples are not representative of the population as the sampling fisherman reported seeing small silversides swimming through the mesh. Stratified subsamples from five samples were aged by analysis of scales taken from the flanks in the area between the dorsal fins (scale reading by Gary Atkinson and the author). All fish were found to be 0+ or 1+. This is consistent with the findings of Jessop and Morantz (1982) and Jessop (1983), who found 2+ fish in research gear set in the Annapolis River, but none in commercial samples from Prince Edward Island. These authors attributed the absence of 2+ fish in the PEI fishery to a possible offshore migration of 2+ animals prior to the fishery, or to the effects of the fishery itself.

There was little overlap in lengths between 0+ fish and 1+ fish (Fig. 3). The maximum 0+ length was 10.1 cm and the minimum 1+ length was 9.8 cm. The cut-off point between 0+ and 1+ is taken as 9.95 cm.

Length frequency plots typically showed symmetrical distributions about the mean of 0+ fish, with a variable number of 1+ fish in higher length classes (Fig. 4). Overall, 1+ fish comprised a mean of 11.7% of samples by number and 18.9% of samples by weight (Table 4). One+ fish were most prominent at Winter River, where they constituted 19% by number and 33.5% by weight of samples on 25 October, and 50.7% by number and 67% by weight of samples on 4 November.

Length-weight analysis of 91 fish revealed a relation of weight = $0.004513\ \text{length}^{3.167}$ (weight in g, length in cm) (Fig. 5).

Forecasts/prospects

Fisheries that are based primarily on young of the year are difficult to manage because previous fisheries provide no predictors of stock size. In silversides, growth overfishing has limited relevance because most 0+ fish presumably die before the fall of the following year. However, excessive exploitation could cause recruitment overfishing, leading to stock collapse due to lack of spawners.

In the absence of detailed biological data, it is not possible to determine if any local silverside stock has collapsed following overfishing. According to fishermen, the periodic appearances and disappearances of silverside landings in various statistical districts (Table 1) are more closely related to market demand than to biological supply. In the Souris area, the source of most silverside landings, fishermen harvested 402 tonnes in 1994, more than landings from the previous six years combined (Table 1). Nevertheless, 1995 landings were higher than the long-term mean. These observations suggest that the heavy 1994 landings were due to an exceptional recruitment pulse and that the high landings did not cause recruitment overfishing.

Given our limited knowledge of stock dynamics, sustainable harvest levels for PEI silversides are not known. If market demand rises, fishing effort could increase markedly because of the large number of inactive licences. Such an increase in effort could lead to an increased risk for stocks.

Conservation of Atlantic silversides on Prince Edward Island is essential for the silverside fishery, but it may also be important for the integrity of the marine environment. Silversides are prey for many other species of fish, birds, and mammals, and excessive exploitation of their stocks could have implications for other marine fauna, including other commercially exploited species.

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Table 1
Landings (kg) and landed value of silversides on Prince Edward Island, 1973 and 1975-1995. 1973 figures are from Jessop and Morantz (1982), 1975-1983 figures are from LeBlanc and Chaput (1991), and other figures are from Fisheries and Oceans Statistics Branch.

Year	District									Total	Landed
	83	85	86	87	88	92	93	95	96		value
1973	0	0	0	24000	118000	0	0	0	0	142000	N/A
1975	0	0	0	20500	48300	0	0	0	0	68900	7000
1976	0	0	0	6200	88100	0	5100	0	0	99400	14000
1977	0	0	0	27900	124400	0	0	0	0	152300	30000
1978	2700	0	0	59600	142000	5000	0	0	0	209400	67000
1979	12000	26500	0	42100	206000	32400	200	0	0	319300	91000
1980	2100	3900	17400	0	36400	0	0	0	0	59700	14000
1981	0	0	300	0	32600	0	0	0	0	33000	
1982	3400	0	0	1600	52000	4000	1500	0	0	62500	
1983	18200	0	0	3500	71500	14200	100	0	0	107500	
1984	27635	0	0	4356	97558	1159	0	380	0	131088	30694
1985	23532	0	0	0	19151	0	4866	0	0	47549	13018
1986	0	0	32045	0	6480	9965	0	27272	454	76216	18553
1987	0	0	0	0	132592	0	4227	0	0	136819	37573
1988	0	0	0	0	74751	0	898	0	4213	79862	22710
1989	0	0	0	0	32914	0	0	0	0	32914	10864
1990	0	0	0	0	81853	0	0	0	0	81853	27068
1991	21919	0	0	0	95841	0	0	0	0	117760	51820
1992	0	0	10713	0	35672	0	0	0	0	46385	17539
1993	1246	0	0	16516	64986	0	0	0	0	82748	29088
1994	4451	0	13848	47861	401983	35191	7240	0	32504	543078	207621
1995	5308	0	0	45677	124669	6202	24736	0	15224	221816	71832
Mean	5568	1382	3378	13628	94898	4914	2221	1257	2382	129627	40073

Table 2
Landings (kg) of silversides on Prince Edward Island by statistical district and by month, and number of silverside licences issued, 1984-1995.

Year	District 83		District 86			District 87		District 88					District 92				District 93		District 95		District 96		Licences
	Oct	Nov	Feb	Oct	Nov	Oct	Nov	Jan	May	Oct	Nov	Dec	Sep	Oct	Nov	Dec	Oct	Nov	Feb	Oct	Oct	Nov	issued
1984	2577	25058				4356				58901	31949	6708				1159				380			11
1985	18967	4565								6982	2272	9897					220	4646					29
1986			31818	227							2229	4251			9965				27272		454		34
1987										88153	44439						1996	2231					36
1988										69674	5077						898				4213		36
1989										32914													36
1990										81853													36
1991		21919						13611		583	81647												42
1992				10713					3535	1730	25440	4967											43
1993		1246					16516			23976	35244	5766											44
1994	4451				13848	16350	31511			257569	142657	1757	1953	12751	17189	3298	1763	5477				32504	103
1995	5308					23600	22000			91100	33600			6202			21000	3700			2100	13100	101

Table 3
Silverside catches (kg) at logbook traps on Prince Edward Island, October-November 1995

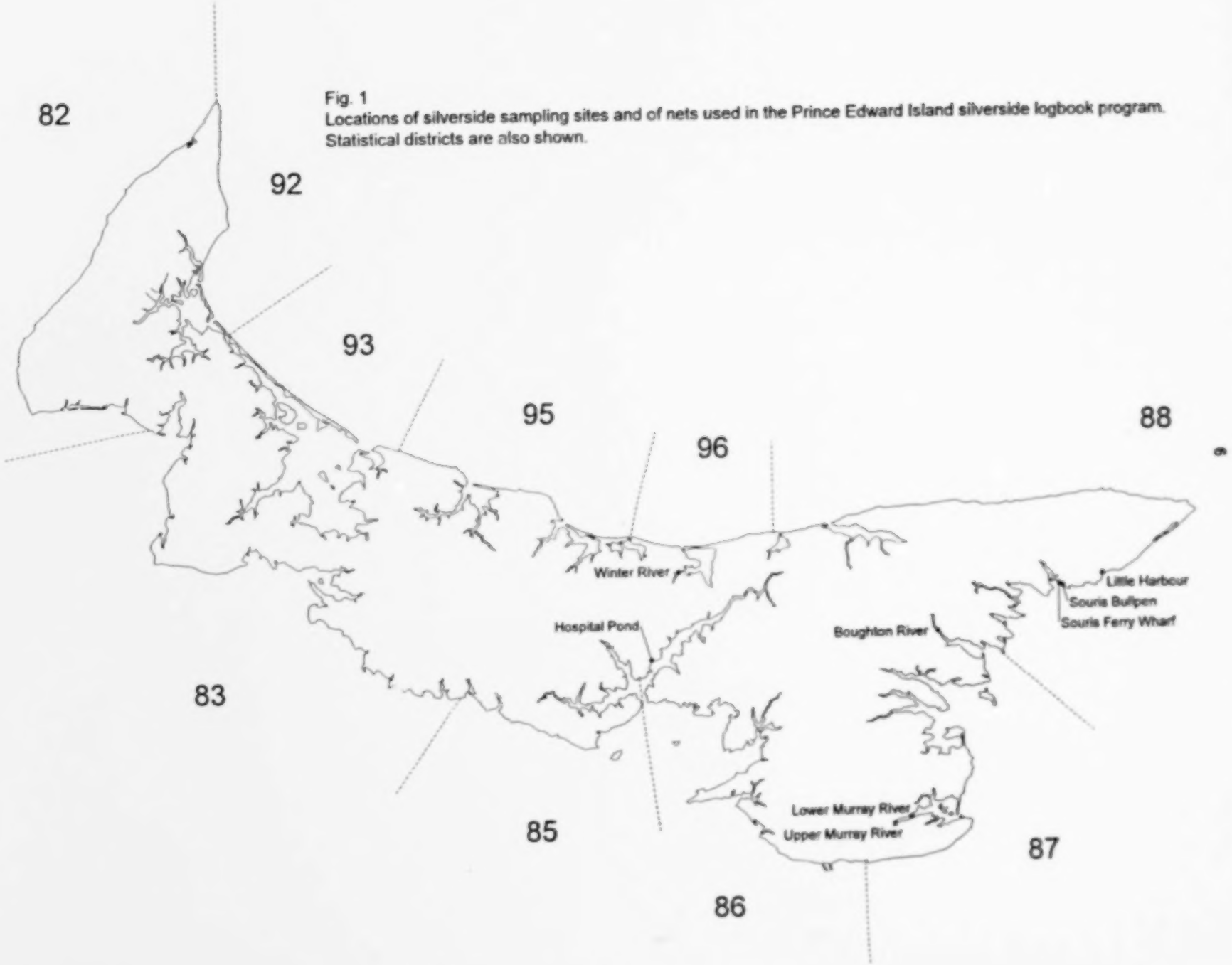
Date	Hospital Pond		Hospital Pond + Winter River		Winter River (2 traps)[a]		Winter River (1 trap)		Souris, West of Ferry Wharf		Souris, Ferry Wharf		Souris Bullpen		Little Harbour, Inner site	
	Plant sales	Landings meaned over the catching period	Plant sales	Landings meaned over the catching period	Plant sales	Landings meaned over the catching period	Plant sales	Landings meaned over the catching period	Hauls	Landings meaned over the catching period	Hauls	Landings meaned over the catching period	Hauls	Landings meaned over the catching period	Hauls	Landings meaned over the catching period
2 Oct	424	424									318	318	272	272	590	590
3 Oct	540	540									249	249	113	113		45
4 Oct		342									454	454	544	544	91	45
5 Oct	685	342										390		572		581
6 Oct		467										390		572		581
7 Oct	934	467										390		572		581
8 Oct		468										390		572		581
9 Oct				468							1950	390	2858	572	2903	581
10 Oct			1403	468							45	45	499	499	2585	2585
11 Oct				219							590	590	2585	2585	1361	1361
12 Oct			438	219					272	272	272	272	1361	1361	1542	1542
13 Oct				603					454	454	454	454	2994	2994		1327
14 Oct			1206	603						295		295		794		1327
15 Oct				334					590	295	590	295	1588	794		1327
16 Oct				334									635	635	5307	1327
17 Oct			1002	334									499	499	2041	2041
18 Oct				1159										159		386
19 Oct			2319	1159									318	159	771	386
20 Oct				361									318	318		873
21 Oct			721	361										635		873
22 Oct				1302							318	318	1270	635		873
23 Oct				1302							45	45	181	181	3493	873
24 Oct			3905	1302										544	3130	3130
25 Oct					735	735							1089	544	2404	2404
26 Oct					4079	4079							1588	1588	2177	2177
27 Oct						1966							1769	1769	3538	3538
28 Oct					3933	1966								287		1270
29 Oct						714								287		1270
30 Oct						714							862	287	3810	1270
31 Oct					2141	714							726	726	1451	1451
1 Nov					1723	1723								121	2223	2223
2 Nov					2332	2332								121	2767	2767
3 Nov					2623	2623							363	121		2011
4 Nov							1162	1162								2011
5 Nov								1106							6033	2011
6 Nov							2211	1106								839
7 Nov							1695	1695								839
8 Nov								244								839
9 Nov								244							3357	839
10 Nov								244							1769	1769
11 Nov							976	244								
No. fishing days		7		16		10		8		4		16		33		40
Catch/trap/day																
Mean[e]		436		329		878		756		329		330		680		1334
SD-all data[b]		72						578		84		139		673		829
SD-single day hauls[c]		169						377		128		182		917		795
Maximum SD-range method[d]		285						307		105		285		1495		1530

[a]Data in the body of the table are for both traps combined. Mean catch/trap/day is 0.5 x the mean for the combined catch.
[b]Means of catch per net per day derived from single traps differ significantly (based on log-transformed daily catch figures including those meaned from a multi-day catching period;F=7.1, P=.00001)
[c]Calculated from all daily landing figures, including those meaned over a multi-day catching period
[d]Calculated from landings where the net was fishing for one day
[e]Calculated by the formula $R/2\sqrt{n/n-1} \geq SD$ where R=(Maximum value-minimum value) and n=number in sample (Sachs 1982)

Table 4
Age distribution of silversides samples, by number and weight. Ages are assigned on the basis of fork length, with fish over 9.95 cm considered to be 1+. Weights were calculated by the formula Weight = 0.004513 Length$^{3.167}$.

	Hospital Pond 18 Nov	Winter River 25 Oct	Winter River 4 Nov	Souris breakwater 30 Oct	Little Harbour 30 Oct	Little Harbour 10 Nov	Lower Murray R. 30 Oct	Upper Murray R. 22 Nov	Total/ mean
Number in sample	300	200	142	332	300	300	220	300	2094
0+ fish									
Number	292	162	70	315	285	284	214	292	1914
Percent by number	97.3	81.0	49.3	94.9	95.0	94.7	97.3	97.3	88.3
Percent by weight	92.2	66.5	32.3	90.0	91.6	90.2	92.1	93.6	81.1
1+ fish									
Number	8	38	72	17	15	16	6	8	180
Percent by number	2.7	19.0	50.7	5.1	5.0	5.3	2.7	2.7	11.7
Percent by weight	7.8	33.5	67.7	10.0	8.4	9.8	7.9	6.4	18.9

Fig. 1
Locations of silverside sampling sites and of nets used in the Prince Edward Island silverside logbook program.
Statistical districts are also shown.



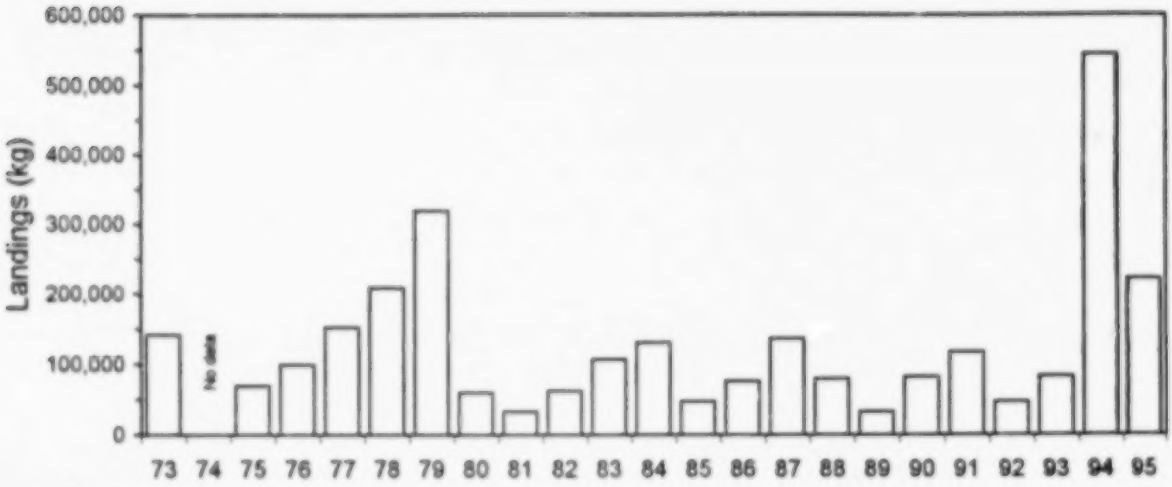


Fig. 2.
Silverside landings on Prince Edward Island, 1973-1995.

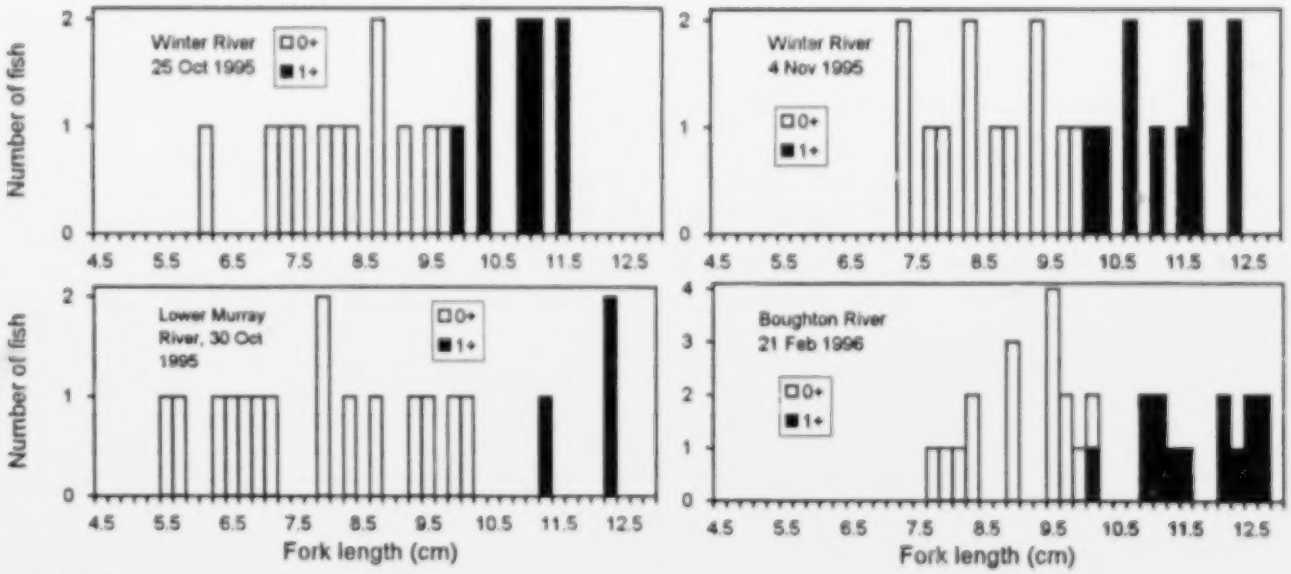


Fig. 3
Ages by length of stratified samples of Atlantic silversides on Prince Edward Island.

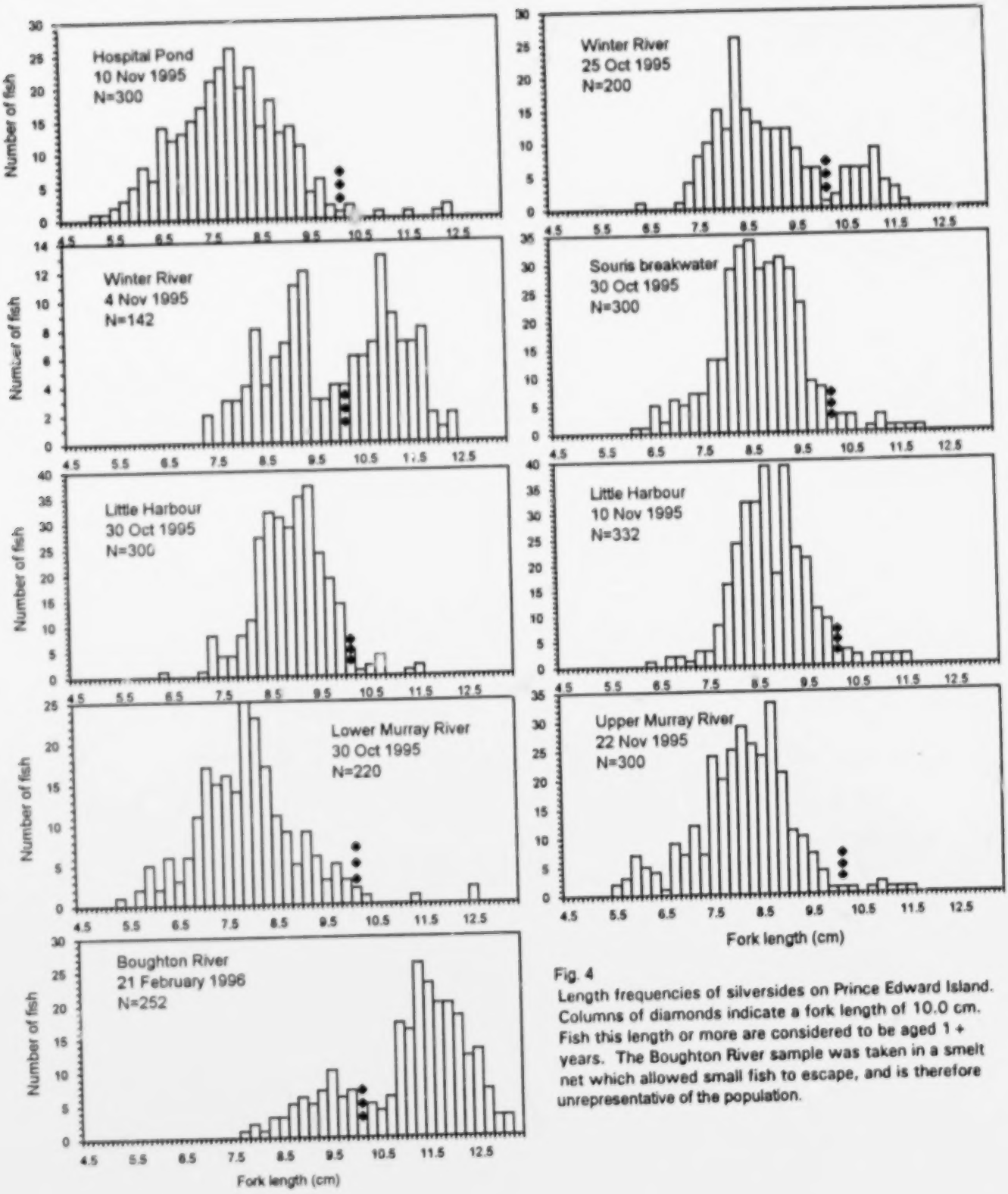


Fig. 4
Length frequencies of silversides on Prince Edward Island. Columns of diamonds indicate a fork length of 10.0 cm. Fish this length or more are considered to be aged 1 + years. The Boughton River sample was taken in a smelt net which allowed small fish to escape, and is therefore unrepresentative of the population.

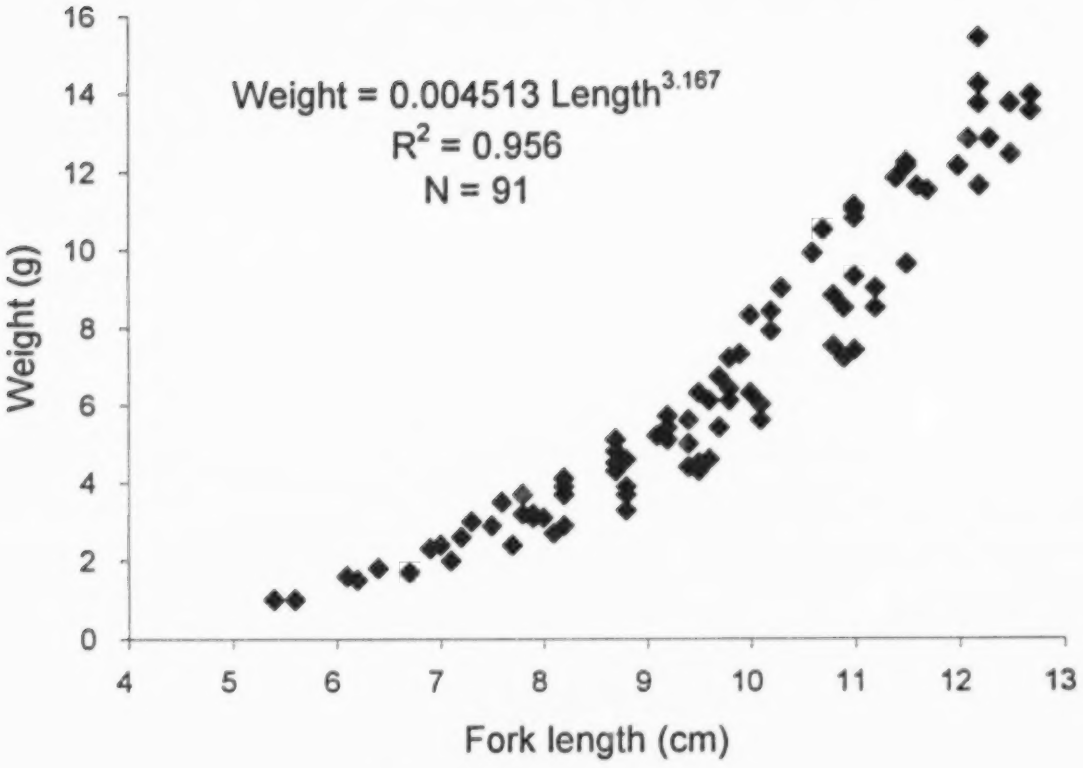


Fig. 5
Length-weight relation of silversides.